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FAO Fisheries Technical Paper No. 81
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FRi/T81
General - Work of FAO

THE ROLE OF FAO IN THE DEVELOPMENT OF INLAND FISHERY RESOURCES

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by

Department of Fisheries
Food and Agriculture Organization of the United Nations

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 1968

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SAST Datos relativos a ciertas especies y poblaciones.

MAST Sinopsis sobre métodos y materias.

OT Sinopsis sobre oceanografía.

IT Sinopsis sobre limnología.

y

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THE ROLE OF FAO IN THE DEVELOPMENT OF INLAND FISHERY RESOURCES

by

Department of Fisheries
Food and Agriculture Organization
of the United Nations

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, December 1968

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THE ROLE OF FAO IN THE DEVELOPMENT OF INLAND FISHERY RESOURCES

Abstract

In view of the need to increase food production, especially animal proteins, inland fishery development has particular significance in the peaceful uses of water. From the estimated 500 million hectares of inland waters of the world, an annual catch of about 7 million metric tons, excluding the catches of subsistence and sport fishermen, is recorded. Although conflicts often arise between optimum fish production and other forms of water use, methods are available for alleviating adverse effects of certain practices on aquatic environments and fish stocks.

In both maritime and non-maritime countries inland fish may make a high contribution both to food supply and national income, and sport fishing has a considerable recreational and economic value. Fish production can be appreciably increased in natural waters and spectacular increases can be obtained by intensive aquaculture. However, inland fisheries are quite vulnerable to environmental changes engendered by man. Cooperation between many agencies is required for an integrated approach to inland fishery development, and resource management of waters belonging to more than one country requires international cooperation.

A major function of FAO and its regional fisheries councils and commissions in the field of inland fisheries is to assist member nations in the assessment and management of these resources and to promote international action to enable their fullest utilization. FAO also organizes training centres and grants fellowships to workers from developing countries for specialized instruction in this field.

Technical assistance has been provided to many countries under the UNDP/TA and UNDP/SF programmes. The Department of Fisheries of FAO also looks after the fishery aspects of the Organization's land and water development projects, and action to solve water pollution problems has been promoted by FAO through the UN and its Specialized Agencies and regional commissions. Through such joint efforts FAO hopes to promote a policy of judicious water use.

Introduction

Almost all natural bodies of water and most artificial ones support fish life and so in any consideration of the peaceful uses of water, the management of fishery resources assumes significant importance. One of the major problems of today is the inadequacy of present food production to meet the needs of the fast growing world population. The contribution that inland fishery resource development can make in alleviating food shortage is being increasingly evidenced in many parts of the world, particularly in the developing countries where there is an urgent need to improve the availability of animal protein. In economically advanced countries, sport fishing in inland waters has a considerable recreational and economic significance and its promotion and management are of particular national concern in some developing countries in connection with tourism and trade.

Fishery use of water is generally not incompatible with other water uses and the rational utilization of the limited inland water resources of the world involves planned multiple use for maximum benefit to the nations concerned.

Of the many uses of water, a number remove large quantities from the immediate hydrological cycle and thus are virtually competitive when the supply of water is limited. For example, water is consumed in the process of being used for domestic supply, in irrigation for agriculture, and animal husbandry, and also to a certain extent in industrial use and power generation. In some of these cases, very large quantities are consumed; e.g. it is estimated that to produce the average human daily food requirement of 2.5 lbs dry weight in terms of wheat, 300 gallons of water are consumed, and in terms of beef, 2,500 gallons. In marked contrast to this the production of fish is virtually non-consumptive of water, though they require adequate quantities of it as living medium. Even though fish and other useful aquatic organisms have distinct water quality requirements, they can often be raised in waters unsuitable for other purposes. In fact, it has been observed that under certain conditions the quality of water may even be improved as a result of fish living in it, and fish ponds have been successfully used for the purification of sewage and other organic pollutants.

There are many instances where water development has been largely beneficial to living aquatic resources and has resulted in greater production of fish, as in a number of multipurpose river valley projects that have given rise to large reservoirs suitable for fish life. Similarly, small ponds constructed for stock watering or irrigation can usually be used for fish. Farmers in many Asian and East European countries have long developed well-integrated and mutually beneficial systems of fish production with agriculture and animal husbandry.

It is, however, not suggested here that there are no conflicts between optimum fishery development and other forms of water use. On the contrary, certain types of land and water use practices are often inimical to aquatic environments and fish stocks.

Fortunately, a variety of methods are available now for alleviating the adverse effects on natural environments or making substitutions intended to make good some part of the resource system injured by the scheme. When there is proper recognition of the relative values of <u>all</u> types of water use and active participation of <u>all</u> interests in the planning of water development projects, the most effective and beneficial use of water can be achieved.

World's Inland Fishery Resources

The exact extent of the inland waters of the world is not known, but the fresh-water areas alone, comprising the rivers, natural and man-made lakes, swamps and ponds, are thought to be around 500 million hectares. In addition to these areas, almost all suitable for fish, the innumerable lagoons, creeks and extensive brackish-water swamps along the coasts in deltaic areas hold high fishery potentials. On account of the very dispersed nature of inland fisheries and the large percentage of subsistence fishing, collection of inland fishery statistics has not made much progress and reliable estimates of production do not exist for many areas. However, about 15 percent of the recorded total world production of fish, which amounts to approximately 7 million metric tons, comes from inland waters. Furthermore, this does not include the unrecorded catches of innumerable subsistence and recreational fishermen. The latter may amount to very appreciable quantities, as for example in the U.S.A. where fresh-water sport fishery catches are estimated to exceed the commercial catch. When one examines the fish production figures of some of the individual countries or areas, the importance of inland fisheries becomes more apparent. In tropical Africa the total production of inland fish is almost as much as that of marine fish. In many countries in Asia and the Far East, inland catches form 40 to 70 percent of the total fish production. In countries with limited or no coastline, the inland fishery is usually the major or only source of fish supplies. All over the world almost the entire catch of inland fish is utilized as human food and hardly any of it, as with much of the marine catch, is reduced to meal, manure or oil. As their market value is often very much higher than that of sea fish, the percentage composition of inland fish in total catches by weight does not reveal the high contribution they make to the national income in some of these countries.

Although certain inland fishery resources have been fairly well exploited, large areas remain greatly under-utilized. Improved methods of fishing in rivers, lakes and reservoirs and the capture of currently unutilized species are likely to lead to an appreciable increase in the landings. Furthermore, several successful management measures have been devised to substantially increase production from streams, rivers, lakes and reservoirs. For example, the complete elimination of existing stocks of uneconomic species by chemical or other means and re-stocking with economic ones, can increase yields 6 to 10 times.

The most spectacular increases in production, however, can be expected from fish and shellfish culture in ponds or other impoundments, where control of conditions can be exercised and effective fish husbandry practised. Production rates vary greatly. In areas with temperate climates, low temperatures during the cold months limit production, but in the tropics higher yields are normally obtained. In either region, by the application of intensive farming methods production can be increased several fold. An average yield of 2,000 kg/ha per annum is easily attainable in the tropics and even now 5,000 to 6,000 kg/ha are obtained in some areas. On a unit area basis, the production in running water fish ponds in Japan and in some of the South East Asian countries is phenomenally high and demonstrates how water flow can be most profitably utilized without affecting its ultimate use for agriculture or other purposes. A recent development is the use of recirculating water systems in fish production units, somewhat similar to water circulation in large aquaria, which greatly lessens the amount of water needed. Successful culture of fish in enclosures made of netting or other suitable materials in lakes, reservoirs, or other sheltered water bodies, opens out vast possibilities for fish production in different types of standing waters. Experience in many countries has shown that the most profitable way of using fresh or brackish-water swamps is to reclaim them into fish ponds. In certain parts of the world there is a tradition of raising fish in rice fields along with rice or when the fields lie fallow. Besides yielding the additional fish crop, fish culture may result in increased yields of rice. The tremendous increase in production that would ensue by raising fish at even modest rates of yield from the existing rice fields in the world could be most spectacular.

Problems of Inland Fishery Development

One of the major problems of inland fishery development has been the lack of adequate recognition of the importance of the resource. This has been particularly so in many countries with successful marine fishery industries. But - probably following the example of such developed countries - even developing countries with limited transport facilities, where marine fish cannot be sold at economic prices in inland areas, have sometimes still placed general emphasis on the development of marine fisheries. The full utilization of both marine as well as inland fishery resources is necessary to meet the requirements for animal protein to feed the ever-increasing human populations of the world. However, it has begun to be realized that marine fish production in some areas, especially of high-quality species, has reached or is approaching a plateau. The maximum use of inland fishery resources and culture of fishes and shellfishes assumes particular significance. Most countries are now striving to attain self-sufficiency in food production and it is obvious how important in this respect inland fishery development can be to non-maritime countries.

As mentioned earlier, production from inland waters, especially small impoundments, can be increased to very high levels indeed and this can usually be done economically. Experience in some countries shows that the cost of inland fish production is relatively low and the organizational and ancillary requirements less than in many industries exploiting marine stocks for direct human consumption. The fact that the large majority of inland fishery operatives are part-time workers is of special significance in developing countries where finding suitable employment for under-employed farmers is of considerable importance. Furthermore, the fact that production takes place generally very close to consuming centres, helps to reduce problems of preservation and transportation and consequently the cost of distribution.

River basin development projects including the construction of dams for various purposes, such as water storage, power development or diversion of water for irrigation, have very seriously affected inland fishery development. Besides being a mechanical barrier to migrations essential to the life cycle of certain species of fish, a dam can cause hazards to fish life due to the changes brought about in the ecological conditions such as reduction of flow, alteration of temperature regimes, and changes in the chemical properties of water in the downstream areas of the dam. In the upstream areas deep inundation of spawning grounds and shallow-water habitats, violent fluctuations in water levels affecting survival of young fish and spawn, as well as the bottom animals and aquatic plants needed by fish, and other changes in the hydrological conditions, occur. There is also the danger of direct loss of fish at dams by their passage into diversion conduits leading to irrigation systems or power plants. Techniques are now available to combat most of these ill-effects. The installation of fish facilities in dams, fish diversion devices at the heads of irrigation systems and protective devices in power plants, together with measures for environmental improvement in upstream as well as downstream areas of dams, can greatly contribute to the maintenance of inland fishery resources. However, the techniques must be used and often at an early stage. An integrated approach to water development must be appreciative of the needs of all interests involved and it must unfortunately be said that the necessary close coordination between all agencies concerned has not always been forthcoming.

The growing danger of pollution of inland waters, now receiving much attention at both national and international levels, is a problem of utmost importance in the maintenance and development of inland fishery resources. The fisheries of many rivers and lakes have been almost completely ruined by pollution; the fisheries of the River Rhine in Europe and Lake Erie in North America are conspicuous examples. With rapid industrialization taking place in developing countries and the widespread use of pesticides in agriculture, this problem is becoming more serious. Techniques are becoming increasingly available to combat most forms of pollution by appropriate treatment, but in many cases when safe effluent disposal is thought of only after the dangers have become evident, the costs may prove high and not always compensated by the benefit derived by fisheries alone. If, however, the polluting

effects of effluents are taken into account right at the planning stage of industrial plants or sewers, satisfactory solutions can normally be reached.

With a view to increasing the area of land for agriculture or for urban expansion, not only swamps but also lagoons and deltaic areas are being reclaimed on a large scale in many parts of the world. The draining of wetland areas may completely eliminate valuable nursery grounds of commercial and sport fishes and channelizing river courses for drainage purposes may have highly detrimental effects on fish life. Although such draining may under certain circumstances be necessary and justified in the interests of overall national good, objective evaluation of the costs and benefits have often shown the need for conserving such areas for fish production.

Weed infestation in inland waters has affected adversely many types of water uses, including fishery development. There are techniques available now to control aquatic weed infestations, but in their use consideration must be given to their effects on fish life. Herbicides and pesticides can cause the decimation of large populations of fish and their food organisms.

A number of problems are faced in the development of inland fish culture. In many developing countries efforts have been concentrated on promoting subsistence level farming, but adequate attention has not been given to large-scale commercial fish culture, which would enable the utilization of suitable modern techniques for obtaining maximum yields. Training of personnel, an aspect of major importance in all spheres of inland fishery work, is particularly important in the field of fish culture, and organization of efficient extension services and training facilities form an urgent need in most countries. Although fish culture has an old tradition, it has not received much attention by scientists until recent years. There are many important problems of research that are required to be carried out as a high priority to maximize yields and minimize costs. Strengthening of the existing research centres and establishment of new centres with facilities for long-term research are immediate needs.

Many inland waters, especially rivers, form international boundaries and joint utilization of the fishery resources of such waters is the concern of a number of countries. Intensive exploitation in one riparian country may very seriously affect production in other countries. Management measures adopted in only one riparian country may have no beneficial effect at all, if the political boundaries do not coincide with the biological boundaries. The need for international action and coordination of efforts is obvious from this, and there are several examples of profitable cooperative efforts in investigating and managing joint fishery resources. The need for even more extended international cooperation has been brought to the fore recently in the investigation of the problems and opportunities for many water uses other than fisheries created by the new man-made lakes in Africa. Besides cooperation between countries concerned, close coordination of the activities of different agencies interested is essential. A variety of disciplines, ranging from limnology and nature conservation to sociology and rehabilitation of human populations are involved and the need for an integrated use of expertise cannot be over-emphasized.

Rôle of FAO in the Development of Inland Fisheries

One of the major functions of FAO in the field of inland fisheries has been to assist its Member Nations in the assessment and management of their aquatic resources, and to promote international action that will enable the fullest utilization of the resources to the benefit of all concerned.

Even though the Organization fully realizes the importance of sport fisheries, it has concentrated its attention on the conservation and development of commercial and subsistence fisheries for food fish in the tropical and sub-tropical regions because of the immediate need for increasing food production in these areas. FAO has endeavoured, within the financial sources available to it, to provide assistance to Member Governments in planning

and conducting investigations and management in this field. Cognizant of the neglect suffered by inland fisheries in many developing as well as developed countries, the Organization has urged appropriate consideration of their value in national development plans.

FAO has directly organized or participated in a number of international missions for the appraisal of the inland fishery resources and for the preparation of plans for their development. The Organization has also, through its regional fishery councils and commissions, the Indo-Pacific Fisheries Council (IPFC), the General Fisheries Council for the Mediterranean (GFCM) and the European Inland Fisheries Advisory Commission (EIFAC), taken a very active part in the appraisal, protection and management of inland fishery resources and the culture of fish and other aquatic organisms in fresh and brackish waters. These regional bodies have been responsible for promoting a variety of research and development programmes in their member countries and for the review and retrieval of information on topics of special interest in the regions. They have provided facilities for workers to meet and exchange ideas and regional symposia and training centres have been conducted under their auspices.

Considering the immediate need for increasing fish production in the developing countries of the world and the role that it can play in meeting this need, FAO has placed special emphasis on warm-water fish culture in its programme of work and taken active steps to disseminate information on the subject. The FAO World Symposium on Warm-water Pond Fish Culture held in Rome in 1966 enabled a review of the progress of fish culture on a global basis and the identification of the gaps in our knowledge as well as deficiencies in development plans. National and international action required for the advancement of the science and progress of the industry was formulated at this Symposium.

As already indicated, the paucity of trained personnel is a major obstacle in the way of proper assessment and management of inland fisheries in developing countries. To alleviate this situation, FAO organizes specialized training courses in inland fisheries and fish culture. Each year it also grants fellowships in these fields to workers from developing countries. These fellowships give the recipients an opportunity to study particular aspects of inland fisheries work in research or demonstration centres or in universities in different parts of the world.

To provide developing countries the necessary technical knowledge for utilization and management of their inland fishery resources, FAO adopted an active programme of technical assistance under the former Expanded Program of Technical Assistance (EPTA) - now the Technical Assistance sector of the United Nations Development Programme (UNDP/TA). In fact, the first Technical Assistance expert to be sent to the field by FAO was a fish culturist, and fish culture continues to be a field in which extensive assistance is provided by the Organization. More than 42 projects have been completed in this field and eight projects are now in operation or about to be initiated, covering over 30 countries. Assistance will soon be provided under the United Nations Development Programme/Special Fund (UNDP/SF) for the operation of a fish culture project in four Central African countries, which will cover both research and training. Under the Freedom-From-Hunger-Campaign (FFHC) of the FAO and the World Food Programme (WFP) also, assistance is provided for the development of fish culture in countries as diverse as Nepal and the Philippines.

Over 23 projects implemented under EPTA or UNDP/TA programmes have related to the study or development of reservoir/lake fisheries or the survey and management of riverine fisheries including water pollution control, inland fishing, fishway design and utilization of fishery products, covering some 18 countries. More than 19 projects have concerned the general assessment of resources and planning of development in 13 countries. Besides these, the general fisheries advisors assigned by FAO to developing countries have also assisted in the development of inland fisheries.

Unlike TA projects, usually carried out by individual experts, the newer Special Fund projects in fisheries of the United Nations Development Programme (UNDP/SF), also executed

by FAO, are of much larger scope, with teams of experts, counterparts and adequate field and laboratory equipment. The first of these in inland fisheries for which FAO was made the executing agency is the Lake Kariba fishery project on the largest man-made lake in the world, and a similar one is soon to be started on Lake Victoria (Kenya, Tanzania and Uganda). Each of these has as major purpose assessment of resources and the evolution of fishery development and management measures. In addition to these - which are primarily fishery projects - FAO will be responsible for SF projects on three other great new man-made lakes in Africa, viz. Kainji Lake (Nigeria), Volta Lake (Ghana) and Nasser Lake (U.A.R. and possibly Sudan). Operated by the Department of Fisheries, these projects are distinctly multi-purpose in nature and may include in addition to fishery research and development, problems of good land and water use, health aspects, wildlife, resettlement of human population, etc., in the areas affected by the reservoirs. The Department of Fisheries also looks after the fishery aspects of about 10 land and water development projects operated by the Technical Department, and the number of all such projects is steadily growing.

Various means of promoting international cooperation in inland fishery development are under consideration by the Organization and the recently formed inter-governmental Committee on Fisheries (COFI), which reports to the FAO Council, has as one of its principal tasks international cooperation in fisheries. At present COFI is examining ways in which the common inland fishery resources of the international waters of Africa can be best shared and managed by the riparian countries.

FAO, in cooperation with the United Nations Organization (UN) and the specialized agencies and regional commissions, has taken an active part in promoting national as well as international action to solve water pollution problems. In addition to the dissemination of information on water pollution and the development of water quality criteria for fish, especially through EIFAC, a basic set of principles has been formulated together with the Economic Commission for Europe (ECE) and the World Health Organization (WHO) for the control of pollution in international river basins. Another study, of both national and international legislation and administration of water pollution control in all its aspects, is nearing completion.

FAO's ability to deal with international aspects of inland fishery work has been restricted by limitations of staff and funds, but with increasing recognition by Member Nations of the importance of the resource, the Organization's ability to deal with the problems, following the creation in 1966 of a Department of Fisheries, is gradually expanding so that it can take an increasingly active role in this most promising field. Through the joint efforts of the units concerned with water use within the Organization and with the cooperation of other United Nations agencies and Member Governments, FAO hopes to promote a policy of judicious water use, reconciling the conflicting demands on the resources for the benefit of all.

FAO FISHERIES TECHNICAL PAPER

This is one of a series of Technical Papers (see inside front cover) dealing with aspects of the work of FAO Fishery Resources and Exploitation Division, including the review of pertinent information on particular topics, to meet requests for assistance, for presentation to technical and scientific meetings, etc. Extra copies can be obtained by application to:

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